

One month after medical treatment: Normal peristalsis, motility four hours, bulbus still defective (Fig. 18).

This method applied to cases of duodenal ulcer has not, up to the present, been productive of as many positive findings as in the case of lesser curvature ulcer. Notwithstanding it would appear that such repeated roentgenological examinations are of value and should be instituted as a routine in the medical treatment of all ulcers.

**CONCLUSIONS.** 1. A method of roentgenological study of the healing of gastric and duodenal ulcer is described. This method consists of repeated roentgenological studies of ulcer patients before, during, and at varying intervals after the institution of medical treatment.

2. This method is of value in the diagnosis, prognosis, control of medical treatment, and selection for surgical treatment of gastric and duodenal ulcer.

3. The method is of value in studying the pathology of the healing process in both clinical and experimental ulcer. Thus far it is not of positive value in the differential diagnosis between ulcer and cancer, although in the future it may shed some light on the much-discussed problem—the frequency of malignant degeneration of callous ulcer.

4. In the use of the method the danger of mistaking normal peristalsis for penetrating ulcer and of the overlooking of the presence of small ulcer because of incomplete or insufficient examination must be borne in mind.

5. These results are presented only as a preliminary report for the purpose of stimulating work by other men along similar lines. It is in no sense to be construed as the final word on the subject, for each new case, as it is studied, brings its own message and suggests new view-points and problems to be interpreted, thus amplifying and possibly negating the conclusions reached in the preceding cases.<sup>16</sup>

## CHEMICAL ANALYSES OF THE STOMACH CONTENTS FROM 100 PELLAGRINS.

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**INTRODUCTION.** In a recent communication by Hunter, Givens and Lewis<sup>1</sup> from the laboratory of the United States Pellagra Hospital at Spartanburg, S. C., the results of gastric analyses of 29

<sup>16</sup> Most of the roentgenological examinations were made for me by Mr. Arendt, in charge of the roentgen-ray department of the Michael Reese Hospital, to whom I herewith express sincere appreciation for his assistance.

<sup>1</sup> Bull. No. 102, Hyg. Lab., Washington, 1916, pp. 42-46.

cases of pellagra in various stages of the disease were reported and discussed. The present paper covers the outcome of work along the same line, presenting data from 100 more cases. For the first time observations on a few cases at short intervals over a long period of time are reported. The investigation is also of interest in that it includes the examination of gastric contents from 24 pellagrous children.

Concerning the gastric disturbance in pellagra there is a general opinion, based on the conclusions reached by numerous students of the disease, that the absence of free hydrochloric acid is to be expected. Marie<sup>2</sup> says: "The gastric juice is often less acid in pellagrins. The hydrochloric acid is diminished." Myers and Fine<sup>3</sup> state, "Anacidity is a condition common in pellagra found in 8 of our 14 cases." Though not evident from their statements, nevertheless the opinion is generally held that free hydrochloric acid is absent, as a rule, in pellagra. Such a condition may be expected, but it is not necessarily found.

The above expectation had its foundation on the statements contained in the report of Lombroso, Filippi and Roncoroni,<sup>4</sup> on the examination of 2 cases for acidity; 10 cases (incorrectly quoted by some as 12 cases) by Cecconi<sup>5</sup> for acidity; 10 cases by Nesbit<sup>6</sup> for acidity and rennin; 20 cases by Johnson<sup>7</sup> for acidity and rennin; 14 cases by Myers and Fine<sup>3</sup> for acidity and pepsin, and the statement of Niles<sup>9</sup> concerning "analyses of 64 cases of undoubted pellagra" for acidity. These reports are of great value, but, with the exception of that of Myers and Fine, none of them throw any light upon the secretion of pepsin in the pellagrin.

Unfortunately, Myers and Fine used Rose's<sup>10</sup> method for the determination of pepsin. We believe this method to be faulty in that it demands neutralization of the gastric juice before determining the pepsin. Using Rose's original method one might find a decreased amount or entire absence of pepsin, depending upon the amount of free acid present. On this account too much reliance must not be placed upon their peptic values.

**METHODS.** During the year 1915 at the Pellagra Hospital of the U. S. P. H. S. at Spartanburg, S. C., I have examined the gastric contents of 76 cases of pellagra, and in connection with the work of the U. S. P. H. S. at a certain orphanage (E. C.) the gastric contents of 24 pellagrous children. The acidity has been determined by Töpfer's (see Hawk,<sup>11</sup>) method and the pepsin by my

<sup>2</sup> Pellagra, translated by Lavinder and Babcock, Columbia, S. C., State Company, 1910, p. 163.

<sup>3</sup> AM. JOUR. MED. SC., 1913, cxlv, 705.

<sup>4</sup> Mario, Pellagra, 1910, p. 201.

<sup>5</sup> Gazzetta degli Ospedali e delle Cliniche, 1911, xxxii, 643.

<sup>6</sup> Tr. Nat. Conf. on Pellagra, Columbia, S. C., State Company, 1909, p. 222.

<sup>7</sup> South. Med. Jour., 1911-1912, iv, 478.

<sup>8</sup> Loc. cit.

<sup>9</sup> Pellagra: An American Problem, Philadelphia, 1912, p. 77.

<sup>10</sup> Arch. Int. Med., 1910, v, 459.

<sup>11</sup> Practical Physiological Chemistry, Philadelphia, 1914, p. 440.

modification<sup>12</sup> of Rose's method. The contents of the stomach have been removed in sixty minutes and in some instances, forty-five minutes after the usual Ewald-Boas (see Sahli-Potter<sup>13</sup>) test meal. In the latter cases the gastric contents have been examined on one day after an Ewald meal and on the following day after a water meal. For the water meal the technic of Rehfuess, Bergeim and Hawk<sup>14</sup> has been used. The Rehfuess tube is given the patient, then 200 c.c. of distilled water introduced, in some cases 150 c.c., and samples for analysis removed after fifteen, thirty, forty-five, and sixty minutes.

Sufficient evidence has been obtained to show that in pellagra the water meal is just as efficient a stimulant for gastric secretion as bread and water. The conclusion is not reached from these few typical examples but from the examination of 30 cases. Table I shows the results of an Ewald meal one day and a water meal the following day.

TABLE I.—COMPARISON OF EWALD WITH WATER MEAL IN PELLAGRA.

Case No.	Date.	Total acidity.	Free hydrochloric acid.	Pepsin.	Vol., c.c.	Sample withdrawn after mins.	Meal.
52	May 29, 1915	105	86	25	72	60	Ewald.
	June 1, 1915	27	19	13	17	15	
		36	26	13	19	30	
		48	35	20	19	45	Water.
		71	55	33	17	60	
126	Aug. 13, 1915	85	56	31	29	60	Ewald.
	14, 1915	40	29	20	15	15	
		56	41	25	14	30	Water.
		76	59	33	17	45	
		87	66	33	22	60	
1	June 2, 1915	84	62	25	62	60	Ewald.
	3, 1915	33	23	13	14	15	
		41	27	17	17	30	Water.
		72	51	20	19	45	
		94	76	25	18	60	
9	June 1, 1915	60	34	20	..	60	Ewald.
	2, 1915	26	13	13	..	15	
		37	24	20	..	30	Water.
		60	35	33	..	45	
		42	23	33	..	60	
129	Aug. 19, 1915	19	0	0	43	60	Ewald.
	20, 1915	16	0	0	21	15	
		17	0	0	17	30	Water.
		20	0	0	10	45	
		21	0	0	42	60	
105	Aug. 12, 1915	17	0	Trace	36	60	Ewald.
		7	0	"	15	15	
		9	0	"	16	30	Water.
		9	0	"	16	45	
		11	0	"	24	60	

<sup>12</sup> Givens, Maurice H.: Bull. No. 101, Hyg. Lab., Washington, 1915, p. 71.

<sup>13</sup> Diagnostic Methods, Philadelphia, 1914, p. 448.

<sup>14</sup> Jour. Am. Med. Assn., 1914, lxi, 909.

Besides the fact shown that water has produced a secretion of acid and pepsin, when it is capable of being produced in pellagra, we believe there is an explanation for it, based upon Carlson's work.<sup>15</sup> Carlson has shown that there is a continuous secretion poured out by the gastric glands in normal persons varying from 2 to 50 c.c. per hour. He states that "the autodigestion of the gastric juice itself is a probable factor in this continuous secretion." We know that when water is introduced into the stomach there is very little absorption, but that it soon passes into the intestines. Is it not then very probable that the products of autodigestion of the gastric juice are absorbed from the intestines and produce the flow of gastric juice in the case of the water meal?

Shortly after admission each patient was given either the Ewald or water meal and the stomach contents removed for examination. In some cases examinations were made at intervals of a week or longer, and this procedure continued for several months.

The results of analyses performed at the Pellagra Hospital are included in Table II, in which the cases are arranged on a basis of decreasing free hydrochloric acid; those at the orphanage, in Table III, are arranged according to duration of disease.

It would be superfluous to give in detail the clinical histories of the cases at either institution. Suffice it to say that there is as great a range and diversity of symptoms as those given in our first paper dealing with this subject. Some were severe, acute cases; some mild, acute cases; some mild, chronic and some moderately mild, chronic. Notwithstanding the large number of cases examined, and the fact that examinations were made before, during, after, and between acute attacks a careful study of the clinical conditions does not seem to permit us to correlate the absence or reduction of free hydrochloric acid and pepsin with any clinical phase of the disease. The absence of acid and pepsin does not seem to be dependent upon the number of attacks or recurrences or the duration of pellagra. This is brought out in Tables II and III, in which the number of years the patient has been subject to the disease is recorded. In Table II the word of the patient, as recorded in the case histories, is accepted. Fortunately in Table III we have the result of an examination by the same competent physician covering the periods noted.

The Ewald meal given consisted of 30 grams bread and 200 c.c. water. Of the 106 times this meal was given there were 19 instances in which more than 70 c.c. were recovered and 28 in which less than 20 c.c. were received. The remainder were within the limit of 20 to 70.

<sup>15</sup> Am. Jour. Physiol., 1915, xxxviii, 248.

TABLE II.—ANALYSES OF GASTRIC CONTENTS FROM ADULT PELLAGRINS.

Case No.	Sex.	Age, yrs.	Date.	Vol., c.c.	Total acidity.	Free hydrochloric acid.	Pepsin.	Mcal.	Time, mins.	Duration of pellagra.
66	M.	30	Mar. 26, 1915	22	120	92	31	Ewald	60	1911-1915.
			April 6, 1915	17	79	61	26	Ewald	60	
52	M.	34	Mar. 20, 1915	22	116	88	41	Ewald	60	1912-1915.
			Mar. 3, 1915	65	101	84	42	Ewald	60	
			0, 1915	100	84	64	31	Ewald	60	
			24, 1915	74	90	65	25	Ewald	60	
			April 6, 1915	40	89	60	21	Ewald	60	
			20, 1915	49	90	59	25	Ewald	60	
			May 29, 1915	72	105	86	25	Ewald	60	
			June 1, 1915	17	71	55	33	Water	60	
			Nov. 11, 1915	33	54	37	33	Water	60	
			Feb. 15, 1916	9	67	46	33	Water	60	
126	M.	38	Aug. 13, 1915	29	85	56	33	Ewald	60	1915.
			14, 1915	22	87	66	33	Water	60	
116	M.	22	10, 1915	4	74	76	20	Ewald	60	1915.
			17, 1915	16	93	69	33	Water	60	
171	F.	22	Feb. 25, 1916	163	74	52	31	Ewald	45	1915-1916. 1914.
1	F.	36	Sept. 3, 1914	123	74	52	31	Ewald	45	
			Dec. 15, 1914	65	76	50	31	Ewald	45	
			Dec. 15, 1915	60	69	53	33	Ewald	45	
			Feb. 13, 1915	80	78	64	33	Ewald	45	
			Feb. 15, 1915	112	76	57	41	Ewald	60	
			Mar. 24, 1915	98	73	49	31	Ewald	60	
			26, 1915	44	95	70	31	Ewald	60	
			April 7, 1915	46	80	52	21	Ewald	60	
			20, 1915	22	74	49	25	Ewald	60	
			June 2, 1915	62	84	62	25	Ewald	60	1915.
			3, 1915	18	94	76	25	Water	60	
103	M.	29	Aug. 12, 1915	137	91	60	25	Ewald	60	
			13, 1915	12	80	52	25	Water	60	
9	F.	24	Sept. 3, 1914	32	72	47	31	Ewald	45	
			14, 1914	7	54	35	31	Ewald	45	
			Jan. 15, 1915	34	51	32	33	Ewald	45	
			Feb. 10, 1915	40	62	39	33	Ewald	45	
			26, 1915	25	57	38	40	Ewald	60	
			June 1, 1915	41	60	34	20	Ewald	60	
			2, 1915	13	42	33	33	Water	60	1914-1915.
			Aug. 9, 1915	38	62	37	33	Ewald	60	
			21, 1915	14	27	14	31	Water	30	
85	F.	22	May 17, 1915	19	66	49	41	Water	60	
70	M.	49	April 7, 1915	23	60	40	8	Ewald	60	
			April 21, 1915	26	71	50	16	Water	60	
			May 13, 1915	52	64	46	25	Water	60	
			Aug. 20, 1915	114	78	51	16	Ewald	60	
			21, 1915	32	61	42	25	Water	60	
88	M.	39	May 27, 1915	58	62	36	25	Ewald	60	1914-15.
			Aug. 17, 1915	32	65	32	25	Ewald	60	
95	M.	44	June 12, 1915	14	52	31	33	Water	60	1915.
			Nov. 8, 1915	122	47	31	21	Water	60	
150	F.	24	Feb. 10, 1916	40	52	34	33	Water	60	1914-1915.
167	F.	46	Feb. 10, 1916	40	52	34	33	Water	60	
160	M.	15	21, 1915	12	65	40	25	Water	60	1912-1914.
77	M.	51	April 21, 1915	15	91	68	21	Ewald	60	
			23, 1915	10	96	74	16	Ewald	60	Do not know.
			May 27, 1915	4	50	28	13	Water	15	
			28, 1915	2	53	31	13	Water	15	
51	F.	30	Feb. 12, 1915	27	62	52	20	Ewald	45	
			Mar. 9, 1915	17	62	41	10	Ewald	60	
			24, 1915	12	37	12	10	Ewald	60	
			April 6, 1915	17	40	18	8	Ewald	60	
			June 1, 1915	6	46	25	10	Ewald	60	
			June 7, 1915	8	10	0	0	Ewald	60	
59	F.	27	Mar. 3, 1915	47	52	35	25	Ewald	60	1914.
			0, 1915	40	45	25	25	Ewald	60	
			26, 1915	9	27	7	20	Ewald	60	
			April 8, 1915	29	18	0	Tr.	Ewald	60	
			22, 1915	15	14	0	4	Ewald	60	
			June 2, 1915	49	23	2	Tr.	Ewald	60	
			3, 1915	11	6	0	0	Water	60	
154	M.	44	Nov. 8, 1915	28	68	50	13	Water	60	
60	F.	22	Mar. 6, 1915	43	48	23	16	Ewald	60	
			11, 1915	47	56	31	21	Ewald	60	
			24, 1915	39	61	34	21	Ewald	60	1915.
			April 7, 1915	15	62	40	16	Ewald	60	

TABLE II—continued.

Case No.	Sex.	Age, yrs.	Date.	Vol., c.c.	Total acidity.	Free hydrochloric acid.	Pepsin.	Meal.	Time, mins.	Duration of pellagra.
89	F.	57	May 28, 1915	29	60	82	13	Ewald	60	1915.
83	M.	68	28, 1915	4	30	9	11	Ewald	60	1914-1915.
			June 1, 1915	2	58	35	11	Water	60	
			11, 1915	3.5	86	69	20	Water	30	
109	M.	7	Aug. 23, 1915	21	57	39	10	Water	45	1914-1915.
115	M.	28	16, 1915	100	56	32	10	Ewald	60	1915.
145	F.	23	Oct. 6, 1915	84	51	37	17	Water	60	1913-1915.
179	F.	30	Feb. 21, 1916	5	47	30	20	Water	45	1914-1915.
151	F.	28	Nov. 4, 1915	26	46	19	25	Water	60	1915.
142	M.	40	0, 1915	122	41	10	25	Water	60	1915.
86	F.	26	May 21, 1915	14	15	7	17	Water	45	1915.
			June 3, 1915	124	44	18	13	Ewald	60	
147	M.	12	Nov. 0, 1915	10	41	16	10	Ewald	50	1915-1916.
143	F.	36	Oct. 0, 1915	25	40	22	20	Water	60	1914-1915.
128	F.	24	Nov. 4, 1915	47	34	19	13	Water	60	1915.
137	F.	33	Oct. 6, 1915	23	35	9	10	Water	45	1915.
118	F.	44	Aug. 14, 1915	103	31	19	17	Water	60	1912-1915.
61	F.	20	April 6, 1915	29	30	6	10	Ewald	60	1915.
99	M.	5	Aug. 23, 1915	137	30	20	10	Water	60	1914-1915.
80	F.	26	May 20, 1915	173	26	18	17	Water	60	5 or 6 years.
148	F.	38	Nov. 6, 1915	3	25	8	10	Water	30	1915.
63	M.	21	Mar. 23, 1915	64	24	5	16	Ewald	60	1913-1915.
161	M.	13	Feb. 15, 1916	10	32	7	10	Water	45	1915.
87	F.	28	Aug. 16, 1915	22	14	0	0	Water	60	
			17, 1915	3	40	Tr.	17	Ewald	60	1912-1915.
122	F.	46	11, 1915	25	37	0	Tr.	Ewald	60	
			12, 1915	5	20	0	Tr.	Water	60	
121	F.	21	11, 1915	89	26	0	Tr.	Ewald	60	1915.
			12, 1915	84	27	0	Tr.	Water	60	
112	F.	19	11, 1915	14	35	0	16	Ewald	60	1914-1915.
			12, 1915	82	19	0	Tr.	Water	60	
133	F.	36	Oct. 7, 1915	27	24	0	10	Water	60	1914-1915.
135	M.	17	2, 1915	150	21	0	10	Water	60	1915.
152	F.	32	Nov. 6, 1915	21	15	0	Tr.	Water	45	1915.
48	F.	33	Mar. 11, 1915	22	14	0	Tr.	Ewald	60	1912-1915.
			April 8, 1915	5	30	0	Tr.	Ewald	60	
			21, 1915	3	23	0	8	Ewald	60	
			June 2, 1915	5	13	0	0	Water	45	
93	F.	33	12, 1915	35	15	0	10	Water	60	1915.
105	F.	23	Feb. 12, 1915	36	17	0	Tr.	Ewald	60	1913-1915.
			13, 1915	24	11	0	Tr.	Water	60	
14	M.	58	Sept. 8, 1914	65	11	0	0	Ewald	45	1914-1915.
			Oct. 17, 1914	77	12	0	0	Ewald	45	
			Nov. 24, 1914	110	9	0	Tr.	Ewald	45	
			Dec. 30, 1914	50	14	0	Tr.	Ewald	45	
			Feb. 11, 1915	112	18	0	0	Ewald	45	
			Feb. 11, 1915	70	13	0	0	Ewald	45	
			Mar. 11, 1915	56	35	7	13	Ewald	60	
			15, 1915	33	34	4	Tr.	Ewald	60	
			April 8, 1915	32	40	7	8	Ewald	60	
			May 25, 1915	14	20	0	0	Water	45	
			May 26, 1915	27	32	7	10	Ewald	60	
2	M.	22	Sept. 2, 1914	86	21	0	Tr.	Ewald	45	1913-1915.
			8, 1914	134	24	0	10	Ewald	45	
			Oct. 17, 1914	144	24	0	Tr.	Ewald	45	
			Nov. 24, 1914	153	14	0	Tr.	Ewald	45	
			Dec. 22, 1914	53	17	0	Tr.	Ewald	45	
			Feb. 30, 1914	100	18	0	Tr.	Ewald	45	
			Feb. 12, 1915	52	25	12	25	Ewald	45	
			Mar. 6, 1915	60	20	0	Tr.	Ewald	60	
			11, 1915	36	21	0	Tr.	Ewald	60	
			25, 1915	6	24	0	10	Ewald	60	
36	M.	55	Oct. 15, 1914	1	0	0	0	Ewald	45	1914.
			Feb. 11, 1915	10	7	0	0	Ewald	45	
			Mar. 25, 1915	27	32	5	Tr.	Ewald	60	
			April 8, 1915	28	50	18	8	Ewald	60	
			May 26, 1915	45	21	0	Tr.	Water	45	
			May 27, 1915	27	25	3	10	Ewald	60	
			Aug. 18, 1915	19	26	0	10	Ewald	60	
129	M.	36	19, 1915	43	19	0	0	Ewald	60	Past 5 or 6 yrs.
			20, 1915	42	21	0	0	Water	60	
73	M.	36	April 13, 1915	53	27	0	0	Ewald	60	1915.
			June 1, 1915	28	10	0	0	Water	60	
			Aug. 18, 1915	10	13	0	0	Ewald	60	
			19, 1915	3	20	0	0	Water	45	
			Nov. 11, 1915	9	15	0	0	Water	30	

TABLE II—continued.

Case No.	Sex.	Age, yrs.	Date.	Vol., c.c.	Total acidity.	Free hydrochloric acid.	Pepsin.	Meal.	Time, mins.	Duration of pellagra.
82	M.	50	May 28, 1915	9	14	0	0	Water	60	1914-1915.
81	M.	48	29, 1915	7	14	0	0	Water	30	1914-1915.
			26, 1915	5	20	0	0	Water	45	
			27, 1915	25	10	0	0	Ewald	60	
94	M.	16	Aug. 18, 1915	6	14	0	0	Ewald	60	1914-1915.
			June 11, 1915	180	21	0	0	Water	60	
50	M.	6	Feb. 11, 1915	38	21	0	0	Ewald	60	1915.
79	F.	19	May 19, 1915	116	18	0	0	Water	60	1915.
100	M.	15	June 3, 1915	58	18	0	0	Ewald	60	1915-1916.
			Aug. 16, 1915	25	18	0	0	Water	60	
69	F.	34	Mar. 8, 1915	10	25	0	0	Ewald	60	1914-1915.
			Mar. 24, 1915	2	10	0	0	Ewald	60	
57	M.	47	April 6, 1915	4	19	0	0	Ewald	60	1914-1915.
			May 26, 1915	15	28	0	0	Ewald	60	
			28, 1915	3	28	0	0	Water	30	
58	F.	40	Mar. 6, 1915	28	18	0	Tr.	Ewald	60	1915.
55	F.	28	3, 1915	65	20	0	0	Ewald	60	1906-1915.
84	M.	23	May 11, 1915	30	21	0	0	Ewald	60	1910-1915.
149	F.	42	Nov. 11, 1915	18	14	0	0	Water	45	1912-1915.
144	F.	27	4, 1915	21	11	0	0	Water	45	1912-1915.
155	F.	30	8, 1915	78	9	0	0	Water	60	1915.
132	M.	67	Oct. 4, 1915	14	15	0	0	Water	60	1911-1915.
140	M.	40	2, 1915	18	21	0	0	Water	60	1915.
141	M.	59	2, 1915	22	22	0	0	Water	60	1913-1915.
131	M.	52	Aug. 24, 1915	6	10	0	0	Water	45	1913-1915.
176	F.	35	Feb. 16, 1916	48	16	0	0	Water	60	1915.
164	M.	32	15, 1916	22	12	0	0	Water	45	1915.
153	F.	31	21, 1916	15	16	0	0	Water	45	1911-1915.

From the work of Boldyreff<sup>16</sup> one would expect some more or less constant relationship between the acidity and the volume of

TABLE III.—ANALYSES OF GASTRIC CONTENTS FROM PELLAGROUS CHILDREN.

Case No.	Sex.	Age, years.	Vol., c.c.	Total acid.	Free hydrochloric acid.	Pepsin.	Meal.	Sample withdrawn after mins.	Duration of pellagra.
200	M.	12	20	93	73	25	Water	40	1 year.
205	M.	8	29	51	34	25	Water	60	1 year.
202	M.	13	7	44	19	10	Water	60	1 year.
207	M.	13	8	42	21	20	Water	60	1 year.
201	M.	10	31	40	22	10	Water	60	1 year.
204	M.	6	5	40	20	10	Water	60	1 year.
203	F.	6	13	35	24	10	Water	20	1 year.
206	F.	15	17	38	20	20	Water	60	1 year.
214	M.	12	13	50	30	33	Water	60	2 years.
216	M.	14	5	42	29	17	Water	60	2 years.
209	M.	8	5	34	21	10	Water	60	2 years.
211	M.	8	10	29	11	10	Water	60	2 years.
213	M.	6	112	26	9	10	Water	60	2 years.
215	M.	13	63	25	12	13	Water	60	2 years.
210	M.	10	98	20	0	Tr.	Water	60	2 years.
212	M.	7	23	19	8	10	Water	20	2 years.
208	M.	11	72	12	0	0	Water	60	2 years.
217	M.	10	97	58	43	20	Water	60	3 years.
218	F.	16	51	51	33	20	Water	60	3 years.
219	M.	17	6	87	62	33	Water	60	4 years.
221	M.	15	46	61	43	17	Water	60	4 years.
220	M.	9	32	46	24	10	Water	60	4 years.
222	M.	13	70	12	0	0	Water	60	4 years.
223	M.	10	9	59	35	17	Water	40	5 years.

<sup>16</sup> Quart. Jour. Exper. Physiol., 1914, viii, 1.

fluid in the stomach. He has shown conclusively that gastric contents of a high degree of acidity are not permitted to enter the intestines until the acidity has been reduced to about 0.14 per cent. hydrochloric acid. He states "The more rapidly the acidity diminishes the more quickly the stomach empties itself." Accordingly one would expect in the case of a high acidity to find a rather large volume of fluid in the stomach and the reverse with a low acidity. No doubt a good part of the water was in the stomach, because of the high acidity due to the secretion of hydrochloric acid. In the case of no secretion of hydrochloric acid, from our ideas concerning the stay of water in the stomach, we would expect the stomach shortly to empty itself. In the cases here reported there is no constant or definite relationship between volume and acidity; that is to say, with a high acidity there are many instances at the end of an hour with a small volume in the stomach, some with a large volume; cases with low acidity of large and small volume; cases with no acidity of large and small volume.

ACIDITY. Before making the divisions later referred to it will be necessary to set some limits. The following table shows the normal standard after the Ewald meal as accepted by the authors whose names are opposite:

	Vol., c.c.	Total acidity.	Free acidity.
Butler <sup>17</sup> . . . . .	20 to 50	40 to 60	27 to 55
Sahli-Potter <sup>18</sup> . . . . .	30 to 70	..	40 to 55
Emerson <sup>19</sup> . . . . .	30 to 70	40 to 60	20 to 60
Farr and Goodman <sup>20</sup> . . . . .	..	40 to 60	
Goodman <sup>21</sup> . . . . .	..	40 to 60	

We concur in the opinion expressed by Bergeim, Rehfuess and Hawk<sup>22</sup> that these values are too low. They do not offer another standard, but state that their total acidity values ranged from 50 to 120, with an average of 77 after their water meal. They have found higher values than the clinicians quoted above in perfectly normal individuals after an Ewald meal. Reviewing their work, and taking it in conjunction with some of our own,<sup>23</sup> it is here proposed to offer as limits of the standard for a normal total acidity 50 to 80. We mean to consider the acidity as subnormal if below the figure 50 and the free hydrochloric acid deficient if below 18. When above 80 we prefer to consider the acidity as of their "hypersecretory type," since no other findings or the clinical

<sup>17</sup> *Diagnostics of Internal Medicine*, New York, 1913, p. 670.

<sup>18</sup> *Loc. cit.*

<sup>19</sup> *Clinical Diagnosis*, Philadelphia, 1913, p. 353.

<sup>20</sup> *Arch. Int. Med.*, 1908, i, 648.

<sup>21</sup> *Am. Jour. Med. Sc.*, 1908, cxxxvi, 734.

<sup>22</sup> *Jour. Biol. Chem.*, 1915, xix, 345.

<sup>23</sup> Givens, M. H.: *Bull. No. 101, Hyg. Lab., Washington*, 1915, p. 71.



evidence warrant calling these cases of hypersecretion. A review of Tables II and III gives:

10 cases of the hypersecretory type or . . . . .	10 per cent.
22 cases of the normal type or . . . . .	22 "
29 cases of the subnormal type or . . . . .	29 "
39 cases with absence of HCl . . . . .	39 "

Pellagra favors neither age nor sex in bringing about the condition found in the stomach; that is to say, free acid and pepsin may be absent in the young or old, male or female. If one desired to make a more discriminating separation a survey of Tables II and III would permit of the selection of the following types of gastric secretion as found in the pellagrin:

- High free acidity with normal pepsin.
- Normal free acidity with normal pepsin.
- Disappearing free acidity with disappearing pepsin.
- Normal free acidity with low pepsin.
- Low free acidity with normal pepsin.
- Low free acidity with low pepsin.
- No free acidity with trace of pepsin.
- No free acidity with no pepsin.

Previous to the present investigation enough cases have not been studied by any one person to allow such a grouping. This shows the great number of possible conditions one would be liable to find in a given case.

As will be seen from the number of types of secretion the free hydrochloric acid and pepsin did not run hand in hand. In the majority of cases in which free acid was absent pepsin also was absent. Accepting 25 to be the low limit for pepsin, we find it normal in 20 cases, subnormal in 32, deficient (10— to trace) in 21, and absent in 23.

A record of the presence of bile in the contents has been kept, but it is not considered worth adding, and thereby further complicating the two tables for two reasons: In the first place it is practically impossible to introduce the tube without causing the patient to gag more or less. In order to overcome this tendency as much as possible, coöperation (on the part of the patient) was sought, but, owing to the class here treated, little was rendered. On this account it is very likely that the strong contraction of the abdominal muscles has forced duodenal contents into the stomach. As a matter of fact the records will bear out this statement. In the second place, as Carlson<sup>24</sup> and Boldyreff<sup>25</sup> show, when there is free normal acidity in the stomach for a few minutes the pyloric sphincter dilates and the duodenal contents enter to neutralize the increasing acidity.

As to how long an attack of pellagra lasts, or whether one attack overlaps onto the next attack or recurrence, it does not seem

<sup>24</sup> Loc. cit.

<sup>25</sup> Loc. cit.

possible to say. On this account it was not considered justifiable to attempt to correlate the number of attacks or recurrences with the presence or absence of acid and pepsin. On the other hand, the number of years the patient has shown lesions of pellagra is recorded, but this does not throw any light on the subject. For example, Cases 66 and 132 have had pellagra five years. In the former there is a "hypersecretory type" of acidity with normal pepsin, whereas in the latter there is no free acid or pepsin. The same thing is shown in the case of the two children, Cases 219 and 222.

Nesbit<sup>26</sup> says, "The indications are that in pellagra, as in all adynamic and asthenic diseases, the hydrochloric acid and ferments of gastric juice progressively diminish." Three cases have been found which will confirm his finding and show the disappearance of free hydrochloric acid more gradually, and in less time than he reports, with the added disappearance of pepsin.

Nesbit's cases.			Writer's cases.				
Case No.	Date.	Free hydrochloric acid.	Case No.	Date.	Total acidity.	Free hydrochloric acid.	Pepsin.
III.	Aug., 1908	35	51	Feb. 12, 1915	62	52	20
	April, 1909	10		Mar. 9, 1915	62	41	10
	Aug., 1909	4		24, 1915	37	12	10 —
				April 6, 1915	40	18	8
IV.	Aug., 1908	8	59	21, 1915	46	25	10
	May, 1909	0		June 2, 1915	18	0	0
				Aug. 8, 1915	10	0	0
VI.	Jan., 1908	24		Mar. 3, 1915	52	35	25
	June, 1909	0		9, 1915	45	25	25
				26, 1915	27	7	20
VII.	Sept., 1907	39	77	April 8, 1915	18	0	Tr.
	April, 1908	20		22, 1915	14	0	Tr.
	Oct., 1908	8		April 21, 1915	91	68	21
				23, 1915	90	74	16
				May 27, 1915	59	28	13
				28, 1915	53	31	13
			29, 1915	37	17		

Conversely, attention is called to Cases 52, 1 and 9, who were watched over eleven and a half, nine and eighteen months respectively, and practically no change was seen. Case 52 is particularly interesting in that he left the hospital, had a severe attack, and returned between the examinations of June 1, 1915, and November 11, 1915, and is still within limits as to acid and pepsin. Cases 14, 2 and 36 were watched over nine, seven and eleven months respectively, and there was nothing to indicate a return to a normal secretion of the stomach, notwithstanding that from a clinical point of view these patients did not show any obvious symptoms

<sup>26</sup> Loc. cit.

of pellagra at the time of the last gastric examination. This is the only record of which we know concerning such a condition in pellagra.

It is not necessary to consider the dietary of these cases, since no difference was noticed in any of the cases under diets of various sorts.

Johnson,<sup>27</sup> in an examination of 20 cases, found that in 14 lacking hydrochloric acid there was a diarrhea, while in no one case with hydrochloric acid was there diarrhea except in one due to a transient cause. He also seemed to think the diarrhea was lessened if rennin were present. A careful review of our cases does not yield such a consistent relation. We have found diarrhea present both in the presence and absence of free acidity.

The following table gives a *résumé* of the conditions found by the various investigators referred to in this paper:

Authority.	Number of cases.	Free hydrochloric acid.							
		Excessive and normal.		Subnormal.		Deficient.		Absent.	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Nesbit . . . . .	10	..	..	2	20	4	40	4	400
Cecconi . . . . .	10	..	..	..	..	..	..	10	100
Johnson . . . . .	20	2	10	4	20	..	..	14	70
Myers and Fine . . . . .	14	2	14	3	21	1	7	8	57
Niles . . . . .	68	15	23	..	..	31	48	18	28
Hunter, Givens and Lewis	24	8	33	2	8	2	8	12	50
Givens . . . . .	100	32	32	21	21	8	8	39	39

Although reported previously, Cases 1, 2, 9, 14 and 36 are included in Table II on account of many subsequent observations. Accordingly the number of cases of Hunter, Givens and Lewis<sup>23</sup> has been changed to 24. With the exception of Niles,<sup>29</sup> who does not give the analyses but makes only a summary statement, all of the other cases have been made to conform to the standard set in this paper for normal, subnormal, and deficient acidities. Reviewing the above available data one sees that the variations in a small number of cases are such as would lead often to erroneous opinions, especially in regard to the absence of free hydrochloric acid.

**SUMMARY.** A careful review of the 100 cases examined, covering over 300 analyses for acidity and pepsin, permits of the following summary:

1. No definite relation can be found between the absence of pepsin and free hydrochloric acid, and sex, age, duration of pellagra, and clinical symptoms.

2. The gastric secretion of children is disturbed along the same general line as that of adults.

<sup>27</sup> Loc. cit.

<sup>28</sup> Loc. cit.

<sup>29</sup> Loc. cit.

3. Free hydrochloric acid and pepsin do not seem to be absent as often in children as in adults.

4. Although the tendency is for acid and pepsin to disappear hand in hand, such is not always the case.

5. It is believed that pepsin and free acid are present more often than has been expected.

### THE INCIDENCE OF CHRONIC FOCAL INFECTION IN CHRONIC DISEASES.

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ALTHOUGH there has been a large amount of literature on the subject of focal infection, the medical profession has been, on the whole, slow to adopt the principles laid down by Rosenow and Billings. On this account I have reviewed briefly what has been done in the medical clinic of the University of California Hospital, hoping to emphasize the importance of this work.

According to this principle many acute and chronic diseases of heretofore unknown origin are believed to be and have in many cases been actually demonstrated to be of bacterial origin. This has been proved by the introduction of new bacterial methods, tissue cultures, and new media which more nearly approach the human tissues from which the bacteria are grown. Tissues which in former years under older methods were found sterile, on culture now yield bacteria in large numbers. The streptococcus in one or the other of its forms has been the most frequently isolated organism. Introduction of these freshly grown cultures of streptococci into animals has shown that the particular organism in question has acquired, to a certain extent, a selective affinity for certain tissues. That is to say, a culture of streptococci from a human stomach ulcer when injected into large numbers of animals will cause a relatively large percentage of stomach ulcers in the animals injected, though many other lesions may also be caused. This strain of streptococcus has acquired an affinity for stomach tissue. The same may be said for streptococci isolated from appendicitis, arthritis, endocarditis, and other lesions. These same organisms isolated from the stomach ulcer may in many cases be found in some chronic focus in the same patient, usually a lesion which does not drain properly. These tooth abscesses, chronic tonsils, sinus and prostatic infections harbor bacteria which must get into the blood stream at such times when the resistance is low and gradually acquire an affinity for some particular tissue which is in time attacked either violently, as is the case in an acute purulent chole-